

The Athenian Mercury:

Tuesday, May 30. 1693.



S I R S,

Quest. 1. **R**eading over in the Countrey your Ninth Volume, I met in Numb. 14. with your Noble Question about the Weather-glass; I like your Notion very well, of comparing it to a Ballance, and no doubt the ascending and descending of the Mercury is caused by the different weight of the Air: But I pray, *Gentlemen*, give me leave to send you my Thoughts about some particulars in your Answer to that Noble Question; And first, You say, *the Quicksilver being once in the Tube, and of a very close Body, it keeps the Air from getting betwixt it and the top of the Tube, when it subsides, and by this means there's no Column of Air to weigh the Quicksilver down besides its own Natural Gravity*; these are your words. **Q.** How if there be no Air between the Mercury and the top of the Tube: **Query**, How will you avoid a Vacuum? I have often put the Mercury into the Tube, and when tis full, clapping my Finger close to the end of the Tube, so that no Mercury can get out, and turning it topsy turvy, no Mercury subsides; but while I flip the Tube into the Cistern, tho' with all the quickness and care imaginable, some of the Mercury falls out, and undoubtedly Air gets in, as may be seen by the bubbling up of the Quicksilver. Next, as to the difficulty you propose, *viz.* Why does the Quicksilver fall low when the Air is full of Rain and Clouds, and therefore apparently should be the heavier? This indeed is a very good Objection, and here pray excuse me if I think you have raised the Devil of an Objection, and cannot lay him again; for whereas your business here was to prove the Air lighter, you take a deal of pains to prove it heavier, which confirms the Objection: Your words are these, *These Vapours being added to the weight of the Air, must necessarily make the Atmosphere heavier, &c.* Now, I say, you should prove the quite contrary, for if the Air mixt with (or under) Vapours, presses heavier on the Cistern, the Mercury instead of descending, would undoubtedly ascend. You afterwards urge the Objection again much to the same purpose, and I think your Answer is altogether foreign to it.

Now *Sirs*, till you make your Answer to this Question somewhat clearer, pray take my Thoughts, *viz.* I take the rising and falling of the Mercury to be caused one of these two ways: 1. I say there is Air from the top of the Mercury to the top of the Tube, and why may not the circumambient Air have an influence (thro' Pores, &c.) on the Air within the Tube, as we find it has on our Corns, and broken bones, which one would think were as much defended from the Weather as the Air within the Tube, (this by the way might be a Query to you, How come my Corns, broken Bones, &c. to be most painful against wet Weather.) 2. But my next and most probable Conjecture about the rising and falling of the Mercury is this, *viz.* I take it, that the Air cannot well exert it self when intermixt with Vapours, so weighs less heavy then on the Cistern, than in dry and clear Weather; the Air seems to be somewhat born up by the Vapours, as a Stone is less heavy in Water than out of it: and that the Air is intermixt with moist Vapours near the ground, is evident, from Marbles becoming at such times very wet. This, *Sirs*, I submit to your better Judgments, being a

Wellwisher to your Society, &c.

Pray Oblige me and the publick with your second Thoughts on this Subject.

S I R,

Ans. We shall according to your desire make some further Considerations on the noble Phenomenon of the *Quicksilvers* arising and falling according to the different pressure of the *Atmosphere*. We shall examine and clear all the Difficulties you have brought, especially that Devil (as you call it) of an Objection, which in your Opinion can't be laid again now 'tis once conjur'd up. We can't a while to consult that place and Volume you have cited, but taking it for granted what you say, We affirm in Answer to your first Objection, (or rather Query) that we do assert a Vacuum, *all things weighing according to their matter, and not their bulk*, as you may be satisfi'd to a demonstration, if you consult Mr. Newtons *Nova Principia Philosophiæ Mathematica*. Possibly we have not express'd our selves so clearly before, as to the subsiding of the *Quicksilver*, We have in a late Mercury prov'd that a Cubick Inch of Air in a Compress'd State that it here near the Earth is able to counterpoize or resist by its Spring as much as a whole Column of Air, which is as high as the *Atmosphere*: And we could show here, if it was not too great a Digression, that a Cubick Inch of Air here near the face of the Earth, if it were taken up as high as the fix'd Stars, would expand into a Bulk many times as big as this Globe of the Earth, provided the Air encreases in expansion proportionably to what we find in going up to the top of a Hill. A Football being but a little more than half blown, in a Valley will grow hard and turgid by such time as you come upon any high Hill, and if you please to try, you will find a very considerable alteration in your Weather-glass in going with it to the top of any common Steeple. You say, *you have often put the Mercury into a Tube, and then clapping your Finger close, it will not subside*: This touches not our Assertion, for by *subsiding* we mean no more than descending as a Natural Ballance, when the other side that should counterpoize it is too light, and not any simple Gravitation, without respect to the Ballance of the Air: But you proceed and say, *That the Mercury does not subside, tho' you turn it topsy turvy, when your Thumb stops the lower end of the Tube, yet whilst you put it into the Cistern, tho' with all the imaginable speed, it subsides so fast, that some of it will fall out*. This is very true, and its impossible it should do otherwise, for when you put the *Quicksilver* into the Tube, the Air to be consider'd as in a certain compress'd state, which with its elasticity or springiness as we said before, does, with that little that there is in the Tube press as much upon the *Quicksilver* as a whole Column of the *Atmosphere*, and therefore thrusts up the Mercury, and holds it in the top of the Glass; but when you take away your Thumb, you are to consider, that that very Air that was in the Tube does in its own compress'd state press as much upon the Air under the Tube, (that is, when you turn the mouth of the Tube downwards) as the Air beneath it does press against it; but when the additional weight of the *Quicksilver* does also press upon the Air beneath it, that Air gives place, and let's the *Quicksilver*, being heavier, subside. As to what you talk of the bubbling of the *Quicksilver*, its nothing but the subtle and finer Air that is in its pores, finding no resistance above in the Vacuum, (betwixt the Mercury and the top of the Tube,) does expand it self, and get out to fill that place. The like Observation was made by Mr. Boyle, when he endeavour'd to raise the Water as high as the *Atmosphere* would permit him by a Pump, all the top stood of a Froth for a considerable depth: Now as to your formidable Objection, which you suppose we rather made stronger by proving

proving just the contrary to what We should, you say the Case was this, *Why does the Quick-silver fall low, when the Air is full of Rain and Clouds?* to which you say our Answer was, That the Vapours being added to the Weight of the Atmosphere, must necessarily make it heavier, &c. Indeed Sir, this is an Answer indeed, if we said no more; We have not that Volume by us at present, but We very well remember that We did say so as previous to what follow'd, which if you please take over again, and if possible in more intelligible Terms: Suppose then that We had very lately abundance of Rain and Clouds, and that the Mercury was at the lowest pitch, and consequently the Air extremely light, now you find that as the Vapours ascend and the Air grows heavier, the Quicksilver which lyes upon the opposite Ballance ascends: Suppose also the Air is now grown close, and the Clouds being crush'd and justled one against another, are too heavy to bear up any longer, now at this time your Mercury is at the highest, and must remain so till the Air is lighter: Suppose yet further, that the Air instead of being so thin a fluid as it is, was a great stagnant Water, covering Hills, Valleys, &c. some Miles high, there's no body can doubt from the daily Examples we see of lesser Quantities, but that the Surface of it would be even at the top, and consequently would make an equal Pressure every where; now if it could be so contriv'd, that a vast *Hiatus* or Gulph should be made in the Earth, the Water that would fall down into that place, would not be only that which was just over it, but it would come from all parts round however distant from it, because the Pressure failing there, would receive its supply for the Circumjacent Parts, and by Consequence the Earth under the circumjacent Parts would have a less and less Pressure upon it. 'Tis the same Case with the Air; for being Condens'd, and falling down suppose at York, that which is here at London also Condensing and gathering into thick Clouds, and becoming more sensible by how much nearer they are to the Earth, does also abate of its Pressure, the Top of the Atmosphere running towards York to supply that place which is less press'd. This is the true and proper Reason why the Quick-silver which is at such an height in the Tube, should in a few Hours time subside so very considerably, tho' there falls no Rain at all in our Country; but if it rains with us, every single Shower does take from the Pressure of the Atmosphere, as so much Rain would weigh, were it measur'd in a Ballance. Now since 'tis plain that every Country in the World is but like a Spot which one may cover with their Finger in respect of the whole Globe, its above a Million of odds but that it may begin to Rain in another place before it does in our own Countrey, and consequently the Mercury will subside before any falls with us, notwithstanding the Air is all the time blackning and growing thick with Clouds, even over our Heads; and you must observe that contrary to the common suggestion, the Air may not possibly be heavier for being full of Clouds, (nay, it's impossible it should without new addition of Vapours) no more than a great Fleece of Wool should be said to be heavier when very loose and expanded than when crush'd together and put into a lesser and more condens'd Bulk; but if ever it should happen that our Countrey or Province should be the first place where the Rain should begin to fall, the Quick-silver would not subside till some Rain had fallen; so that 'tis neither the presence or absence of Clouds that causes the Quick-silver to fall or rise, but actual showers to ease it, or the addition of actual Exhalations to press more upon it: So that 'tis only a Wordy, Noisy Objection, to say that the Quicksilver falls lower when the Air is full of Rain and Clouds, because full of Rain and Clouds; but it falls lower because it rains somewhere or other, and the Clouds gathering over us are only Signs of such Rain.

To your two Observations at the last, We think they are both defective: As to the first, We deny any Air is at the top of the Tube, unless some that is so refin'd as would come into the Millionth part of a Pin's Head, perhaps as fine as the Atmosphere, a thousand Miles

high, which can't properly be call'd Air, nor influenc'd by the circumambient Air about it, which can't come at it. As for your Corns, &c. 'tis a little too Unphilosophical in this place, and may have Answer elsewhere. For the second, viz. The Air's intermixing it self with Vapours, 'tis wholly unintelligible, and you shou'd have made a distinction betwixt Air and Vapour, and how exerting or not exerting helps on with the Gravity, is as dark: If you please to Consider on it, you may have other Thoughts on it, which is all at present from

ATHENS.

Quest. 2. I took a Tube of 20 Inches long, open at both Ends, and fill'd it full of Mercury, then unstopt the lower Orifice, and I found the Pulp of my Thumb that stop't the Upper Orifice forcibly thrust in, as if it was drawn down with a Weight: Now according to the Hypothesis of the Weight of the Air, the Mercury ought to press against the part that stops the upper Orifice, and by consequence the Pulp of my Thumb not thrust into the Cavity of the Pipe: I desire you to reconcile this with the forementioned Hypothesis?

Ans. The Reason of this is very evident, for there being 20 Inches of Mercury in the Tube, supported by the Pressure of the Air at the lower Orifice, which Air would buoy up 30, therefore the Mercury in the Tube presseth against the Pulp of the Thumb at the upper Orifice with a force, able to bear up only 10 Inches of Mercury, but the external Air presseth against the Parts without the Tube, with a force able to bear up 30 Inches. Now since the outward parts are press'd upon by 30, and the inner by 10, therefore the Pulp of the Thumb will give way, and be thrust into the Tube.

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